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Subject review: Image segmentation techniques

Amal Abbas Kadhim *, Wedad Abdul Khuder Naser and Safana Hyder Abbas

Department of computer science, University Al Mustansiriyah, Baghdad, Iraq.

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Abstract

Image segmentation is the most critical functions in image analysis and processing. Image segmentation is a mechanism used to divide an image into multiple segments. It will make image smooth and easy to evaluate. Segmentation is the most essential and crucial process for facilitating the delineation, characterization, and visualization of regions of interest in a particular image. The main goal is to make image more simple and meaningful. This survey present background reviews of various image segmentation techniques, evaluates them and presents the issues related to those techniques.

Keywords: Image segmentation; Thresholding techniques; Fuzzy HNN; Clustering; K-means bunching approach

1. Introduction

The technique of partitioning a digital image up into multiple parts is known as image segmentation. Simplifying and/or transforming an image's representation into something more meaningful and understandable is the aim of segmentation. Image segmentation is frequently used to locate objects and boundaries in images (such as lines, curves, etc.) [1].

Many difficulties face segmentation algorithms; Image segmentation is a low level process in image analysis, therefore segmentation algorithms divide pictures using low level concepts of images such as pixel intensity, pixel color, texture, and so on. Local structures of images, such as flat regions and borders, are shown differently. The lack of accurate criteria for evaluating segmentation algorithms presents another difficulty.

Many projects these days are concentrating on the segmentation process. In the literature, segmentation techniques or algorithms have been discussed. However, there isn't even a single strategy that can be considered to be a better technique for many types of images; such strategies are only suitable for particular images and applications. [2,3] .

Many image segmentation techniques have been developed by researchers and scientists, segmentation techniques are discussed and evaluated in this survey.

2. Literature Survey

Many image segmentation techniques have been developed by researchers and scientists, some of the most important and widely used image segmentation techniques are shown below.

Salem Saleh Al-amri, has used the Mean, Pile, HDT, and EMT approaches on three satellite images to determine which technique produces the best segmented image. The best thresholding techniques that outperforms all other

* Corresponding author: Amal Abbas Kadhim

thresholding techniques are HDT (Histogram Dependent Technique) and EMT (Edge Maximization Technique), according to experiments and comparative analysis of techniques. [4].

Mai, D. S. et al, offers a method to improve fuzzy c-means clustering calculations by using the criteria to transfer the bunch model to the normal centroids that are already determined based on testing. Results demonstrate that the suggested calculation has improved the nature of groups for a problem class of discovering land cover change. [5].

Kaiping WeI . Have discovered that the current techniques for performing image segmentation are time consuming and expensive in terms of computing. For real-time applications, it is a big problem. They suggested a brand-new 2-d Otsu algorithm and Particle Swarm Optimization (PSO)-based threshold-based segmentation technique (TOPSO). December 2013 issue of TOPSO 166 Journal of Image and Graphics, Vol. The PSO technique was used by the 2013 Engineering and Technology Publishing doi: 10.12720/joig.1.4.166-170 algorithm to find the best threshold for the segmentation process. They use Matlab 7.0 to implement the suggested hybrid method. [6] .

Mathur et al. Proposes using the K-means bunching strategy to locate edges that are fuzzy. The K-means bunching approach is used to create different groups that are then added to the Mamdani fuzzy deduction framework. Reproduction evidence suggests that the fuzzy based framework's K-means grouping strategy for age-based edge parameters improves the edge picture for MRI images. [7].

Karoui , proposes a new unsupervised image segmentation technique utilizing texture statistics and level set methods. They claim that their method is different from other approaches since it does not presume independent variables and does not restrict itself to first order grey characteristics. The feature selection stage in the implementation involves adjusting the weights of each feature to achieve segmentation. In the experiment phase, the number of distributions is determined by the filter response histogram, and the energy of each band's image wavelet is determined by the haar wavelet. The level sets are initialized again using PDE. Results have demonstrated that a zebra image has been correctly segmented. [8].

Pillai et al. Provides a method for picture steganography that groups the image into different portions and conceals information in each of the sections. Along with steganography, a mix of cryptography and bunching procedures has been used. This gives significantly higher security because the encryption key is also inaccessible to the assailant. [9].

Yong-mei Zhou. Using the mean-shift clustering method, a novel region-based image segmentation technique has been proposed. They begin by extracting the color, texture, and location features from each pixel in an image, then use mean-shift clustering to create clusters based on those features, label each region, and then segment the image into segments based on these labels. To put their approach into practice, they used Matlab 7.0. The results of their method are better in terms of speed and segmentation, according to experiment. [10].

Civahir Cigla , attempts to improve the normalized cut image segmentation method by presenting a new graph theoretic color image segmentation method. They used an image with a weighted undirected graph, in which the nodes represent in for the regions and the weights between them indicate how closely related the regions are in terms of intensity. The problem of extra segmentation, where more regions are formed for the image, has been resolved by their modified normalized cut method. On the basis of MSE criteria, experiments are carried out on cow images, mosaics, and multi-resolution NC images, and the results are compared with the NCIS algorithm. The results showed that the suggested strategy enhances the NCIS algorithm. [11] .

Yu Xiaohan , based on region growth and edge detection methods, suggested a new image segmentation technique. Their hybrid method enables the segmentation process avoid errors when the both strategies applied separately. While 2nd order derivative is used for edge detection, region growth is used to locate the image's edge pixels. On 3D MRI image data, experiments are conducted. Following edge detection, smoothing is done using the Gaussian technique. According to results, their method is better in order to preserve more edge information. [12].

Yadav et al. Suggests that a specialized picture division method has been developed, which is based on the picture's color using unsupervised K-means clustering. The suggested method iteratively enhances a compelling fragment of the colored picture depending on the situation. This method makes it very simple to examine the results and analyze the particular question in the image. [13].

Wesolkowsk . Have segmented edges and regions of hybrid color images using Markov Random Fields. First, the edge detection algorithm is used to implement the line process. To identify edges, a vector angle measure is applied as a pixel

distance measurement. Their method has the same drawbacks as the region growth method and is a pixel neighbor model, which is its fundamental flaw. The MRF model is evaluated using a parameter estimation technique. [14,15].

Ying-Tung Hsiao, who combined morphological operator with region expanding technique, offered a new image segmentation technique. They first enhanced the image with morphological closure operation before performing edge detection with a dilation residue edge detector. After performing the region growth method for mage segmentation and deploying growing seeds, region merging and edge detection are then carried out on the images. They perform experiments using table tennis, girls, and MRI images. To improve edge detection results, the snake boundary condition method is used. Every experiment is run in Visual C++. [15] .

Nabeel, F.et al presents a simple, effective, and comprehensive image division and combining approach. It enhances the division process of colored images by combining K-means clusters based on histograms in several color spaces. The K-means (Euclidean Distance) approach is used to group the pixels in the re-quantized shading spaces into classes. [16].

Amjad Zaim , has found that it is difficult to segment prostate borders from ultrasound images for surgical procedures. A brand-new edge-based segmentation method for prostate ultrasound images was suggested. The ultrasound image' edges are detected using phase symmetry. To reduces the noise, a median filter is applied. The final edge-based segmentation image is produced using edge extraction and edge linking. Their method's primary benefit is that it doesn't require manual intervention. When their method's output is compared to manually segmented contours, accuracy of 87% is found. [16].

Gour Chandra Karmakar proposed a brand-new picture segmentation technique based on fuzzy rules that may take into account the spatial connection between pixels. To measure the region's closeness and determine the spatial relationship among pixels, three different membership functions are employed, including the Membership function for Region pixel distribution. When using their method, such as the FCM algorithm, there is no need to define parameters. To segment an image, fuzzy rules employ the three membership functions mentioned above plus an IF-THEN rule structure. FCM and the suggested technique are implemented to X-ray and human vocal tract images in Matlab 5.3.1. Results have shown that GFRIS performs better than FCM and accurately isolates the object from background. [17].

Amol S. Pednekar . Propose a new fuzzy connectedness-based dynamic weights-based image segmentation technique. Traditional segmentation techniques, according to the author, cannot deal with the problems caused by fuzziness in medical images. In order to dynamically adjust the linear weights in fuzzy connectedness, they develop the DyW algorithm. While multiple seed is used for infrared face segmentation, the seed DyW algorithm is effectively applied to images of many modalities. In comparison to previous algorithms, it is discovered that the DyW image segmentation algorithm provides 99% greater accuracy [18].

Pandey, S. et al, suggests a dataset of semantically assembled images. It makes no use of any fundamental information on the number of groups framed or the semantics of the images. We use the agglomerative technique for progressive grouping calculation to acquire results. A delegate image represents a group at each intermediate level. There is some data loss as a result of this picture continuing to exist for every other picture sharing space with a group. The quantity of bunches is obtained as a result of this unfortunate event. [19].

Liu Yaju, has proposed a new fuzzy color image segmentation algorithm based on fuzzy dissimilarity and feature divergence. They claim that their algorithm enhances segmentation quality. Their algorithm uses the watershed technique to extract subimages with feature vectors. First, a color image is transformed to a grayscale version, followed by the creation of a histogram, clusters, and an application of FCM to each cluster. The generated image is then subjected to erosion, dilation, and region growth.. The segmented region image is then produced after that. Photographic images, or images with a complicated backdrop, are used in the image. Results have indicated that fuzzy approaches produce better results [20].

Xuejie Zhang, created a new R-G-B-S-V (i.e., RGB and HSV) cluster space based Fast learning Artificial Neural Network (FLANN) based color image segmentation approach. In the first step, noise is eliminated with a 3*3 averaging filter to reduce distribution of colors. In the second step, HSV conversions are used to convert pixels to RGBSV space. To create an image cluster result, FLANN clustering is used. Following that, pixels of the same color are separated. Each image segment is assigned a segment number. Effects of neighborhood size and tolerance are seen. Results showed that the suggested algorithm created perfect segments for the image's colors. [21].

Farhad Mohamad Kazemi [22] To use it for image segmentation, a quick C means-based training of the fuzzy hopfield neural network was developed [23]. 2-f Fuzzy HNN is the foundation for the objective function. The average distance

between the image pixels and cluster centroids was determined by this objective function. They first create clusters from the input data, do normalization (i.e., convert the data to grey scale), calculate centroids, compute distances, find new centroids, and compute new membership function values using fuzzy C-means. [24].

3. Conclusion

This survey provides a review of different segmentation techniques due to their importance in digital image processing such as border, region, and hybrid techniques in real-world applications. These techniques are studied wholly to find out which of these techniques is more efficient and Speed. The survey showed that Fuzzy HNN and the DyW image segmentation algorithm provide a faster speed and greater accuracy segmentation as compare to other techniques.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have no conflict of interest.

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